PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Before the Board of Patent Appeals and Interferences

In re Application of: **Thomas BEHR, et al.**	Examiner: **Alexander P. TAOUSAKIS**
Application No.: **10/573,273**	Group Art Unit: **3726**
Filed: **12/18/2006**	Confirmation No: **9235**

For: **CRANKSHAFT COMPRISING A COMBINED GEAR WHEEL AND METHOD FOR THE PRODUCTION AND USE OF SAID CRANKSHAFT**

Attorney Docket No: **3926.245**	Customer No: **41288**

Mail Stop: Appeal Brief - Patents
Commissioner for Patents
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APPEAL BRIEF

Sir:

This is an appeal from the final rejection in the Office action dated October 26, 2010, finally rejecting claims 4,5 and 7-14, and maintaining the Restriction Requirement pursuant to which claims 3 and 6 have been withdrawn.

Appellants submit this *Appeal Brief*, including payment in the amount of $500.00 to cover the fee for filing the *Appeal Brief*.

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Real Party in Interest:

This application is assigned to Daimler AG of Stuttgart, Germany. The assignment has been recorded by the USPTO on August 1, 2006, at Reel No. 018038, Frame No. 0218.

Related Appeals and Interferences:

No related appeals or interference proceedings are currently pending which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

Status of Claims:

Claims 3 and 6 are withdrawn pursuant to a final restriction requirement under appeal.

Claims 4, 5 and 7-14 are rejected and under appeal.

In a Preliminary Amendment filed March 23, 2006:

- crankshaft claim 1 was incorporated into "use" truck claim 4, and also reformatted according to US practice and presented as new clean claim 5. Claim 1 was accordingly cancelled.
- process claim 2 was formatted according to US practice and presented as new claim 6. Claim 2 was accordingly cancelled.
- process claim 3 was amended to depend from new claim 6.

In Amendment A filed August 16, 2010:

- claims 3 and 6 were withdrawn and amended for formalities,
- claims 4 and 5 were amended for formalities, and
- new claims 7-14 were added based on original claims and paragraphs [0010] and [0014] of the specification.

Status of Amendments:

The Examiner has entered Amendment A filed August 16, 2010. No amendment was filed subsequent to the final rejection. Accordingly, the claims under appeal are the claims as amended in Amendment A. *A Notice of Appeal* was filed on January 26, 2011.

Summary of the Claimed Subject Matter:

There are three independent claims in this application: claims 4, 5 and 6.

Motors with a high power density and ignition pressure, for example diesel engines, require crankshafts with combined gear wheels, which are subjected to high loads, particularly in the areas in which they are joined. Hardened gear wheels are conventionally joined to forged steel crankshafts by material joining (welding), form-fitting engagement (screwing) or by interference fit (specification, paragraph [0004]).

Independent **claim 4** claims a diesel powered vehicle, wherein:

(a) the diesel engine includes a crankshaft with combined drive gear wheel;

(b) both the crankshaft and drive gear wheel are cast as one piece. Conventionally, the number of the processing steps for manufacturing a crankshaft with combined drive gear wheel requires comparatively lengthy manufacturing times, which drives up costs (paragraph [0008]). Casting the crankshaft together with the combined gear wheel as a single piece reduces manufacturing times and cost by (paragraph [0010]), eliminating the joining step, and elevating the degree of design freedom (paragraph [0011]);

(c) crankshaft and gear wheel exhibit differential hardening (see (e) below);

(d) both crankshaft and gear wheel are manufactured from tempered ductile iron (ADI). As disclosed in paragraph [0012] and [0013] of the specification, tempered ductile iron (ADI), a cast iron with spherical graphite which, following targeted thermal treatment (tempering), exhibits improved wear characteristics. Further, ADI has approximately a 10% lower weight than the conventionally employed steel, and exhibits excellent thermal and mechanical characteristics, in particular high strength up to 1600 N/mm^2. Due to these positive characteristics of the ADI material one can completely dispense with the conventionally required step of hardening of the gear wheel;

(e) the hardness of the gear wheel is further increased by at least one of (a) local differential thermal treatment during ADI heat treatment and (b) peening. As disclosed in paragraph [0015], the area of the gear wheel preferably exhibits a higher hardness relative to the rest of the cast part. This can be accomplished by suitable differentially controlled temperature exposure during the thermal treatment of the different cast partial areas, or by cold hardening (so called shot blasting or peening); and

(f) the friction wear resistance of the gear teeth is increased by application of carbide containing coatings (CADI). As disclosed in paragraph [0016], the hardness of the cast part can be increased locally, for example the teeth, by locally introducing carbide into the melt.

This can occur using carbide-containing coatings or finishings. Thereby one obtains an ADI microstructure with supplemental introduced carbides (so called carbidic ADI=CADI). The thus hardened areas exhibit an increased resistance to wear.

Claims 4 and 5 differ only in the preamble. Where claim 4 is directed to a diesel powered vehicle with the inventive crankshaft, claim 5 is directed to the crankshaft *per se*. As the limitations in the body of claim 5 are identical to claim 4, reference to the specification is omitted.

Independent **claim 5** claims a *crankshaft with combined drive gear wheel,*

wherein both crankshaft and drive gear wheel are cast as one piece,

wherein crankshaft and gear wheel exhibit differential hardening,

wherein both are manufactured from tempered ductile iron (ADI),

wherein the hardness of the gear wheel is further increased by local differential thermal treatment during ADI heat treatment and/or by peening, and

wherein the friction wear resistance of the gear teeth is increased by application of carbide containing coatings (CADI).

Turning to withdrawn claim 6, claims 5 and 6 are related as product-by-process and process for making the product. Where claim 5 claims a combined crankshaft and drive gear wheel cast as a single piece, claim 6 claims a method for making a combined crankshaft and drive gear wheel comprising casting as a single piece.

Independent **claim 6** claims a process for manufacturing a crankshaft with combined drive gear wheel, wherein

both *crankshaft and drive gear wheel are cast as one piece,*

a base alloy suitable for tempered ductile iron (ADI) is employed as casting material and heat treated,

at least one of (a) the heat treatment is controlled locally differentially such that locally the hardness is further increased, or (b) the durability of the gear wheel is locally increased by peening, and

the friction wear resistance of the teeth of the gear wheel is increased by application of carbide containing coatings (CADI).

As the limitations in the body of claim 6 correspond with claims 4 and 5, reference to the specification is omitted, except that paragraph [0018] is referenced for teaching that, for casting, base alloys are employed which are suitable for final tempering or annealing. Thereby the crankshaft with combined drive gear can first be cast in the final or completed

form, and thereafter be tempered (thermal treatment), whereby the advantageous mechanical and thermal characteristics of the ADI (tempered ductile iron) come to exist. Alternatively, the thermal treatment could also occur directly subsequently to casting, and a possibly use-specific final processing could follow thereafter.

Grounds of Rejection to be Reviewed on Appeal

1. Whether or not the Examiner properly maintained the restriction requirement between process claims 3 and 6 and the remaining (product-by-process) claims.
2. Whether or not claims 4-5, 7-9 and 11-13 are obvious over Hoyes et al (WO 0047362) in view of Wilde et al (6,258,180), further in view of Oyelayo et al (2002/0098392), under 35 U.S.C. § 103(a).
3. Whether or not claims 10 and 14 are obvious over Hoyes et al (WO 0047362) in view of Wilde et al (6,258,180), further in view of Oyelayo et al (2002/0098392) as applied to claims 4-5 above, further in view of Kawanami et al (5,409,415), under 35 U.S.C. § 103(a).

Argument

PROCESS CLAIMS 3 AND 6 DEFINE THE SAME INVENTION AS PRODUCT-BY-PROCESS CLAIMS

Appellants chose to claim the present invention in two forms of claims: product-by-process claims and process claims. See MPEP 1893.03(d) "Unity of Invention": "As provided in 37 CFR **1.475**(b), a national stage application containing claims to different categories of invention will be considered to have unity of invention if the claims are drawn only to one of the following combinations of categories: (1) A product and a process specially adapted for the manufacture of said product …"

As provided in MPEP §1850, the decision with respect to unity of invention rests with the International Searching Authority or the International Preliminary Examining Authority. A group of inventions is considered linked to form a single general inventive concept where there is a technical relationship among the inventions that involves at least one common or corresponding special technical feature. The claims have already been examined for unity and a decision has already been made with respect to unity of invention, finding the product-

by-process claims and the process claims to define the same invention, and as the claims have not been materially altered. Accordingly, the decision should stand.

According to the Examiner, the inventions listed as Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features. According to the Examiner the features which are common to all of the claims are: combined crankshaft and drive gear wheel which has been heat treated and has a carbide layer; however, the features common to all claims do not constitute "special technical features" since they do not make a "contribution" over the prior art (Hoyes and Oyelayo).

Appellants respectfully point out that the special technical feature of the present invention is:

- both the crankshaft and drive gear wheel are ***cast*** (not forged) ***together as one piece***,
- the crank shaft and gear wheel exhibit ***differential hardening*** (claim 4, line 3; claim 5, lines 2-3),
- both the crank shaft and gear wheel are manufactured from ***tempered ductile iron*** (***ADI*** – a cast iron with spherical graphite which, by targeted thermal treatment, exhibits improved wear characteristics); ADI being about 10% lower in weight than conventionally employed steel,
- the hardness of the gear wheel is further increased by at least one of (a) ***local differential thermal treatment*** during ADI heat treatment or (b) peening, and
- the friction wear resistance of the gear teeth is increased by application of carbide containing coatings (CADI) (e.g., into the melt to obtain an ADI microstructure with supplemental introduced carbides).

Hoyes ***forges*** a crankshaft with gear wheel ***without teeth*** and flange. Since the part is forged from SAE 1548 or SAE 1046 ***steel***, and the gear teeth are not formed in the forging step, but rather must be cut into the gear wheel in a subsequent step. This necessarily precludes that any microstructure treatment imparted to the surface of the teeth for increased friction wear, as by introducing carbide into the melt or application of carbide coatings according to the present invention, remain intact.

Hoyes discloses a uniform heat treatment of the entire crankshaft, or induction heating of the gear wheel (apparently ***prior*** to cutting the gear teeth), but without the use of the

tempered ductile iron (ADI), without the casting, without the integral forming of teeth, without the differential increased carbide in the gear teeth, thus Hoyes is far from the present invention.

Oyelayo discloses plasma treatment (sputtering) as an alternative to heat treatment. This treatment is non-selective for the entire part. Since sputtering acts on the entire piece, it is not even possible to carry out selective treatment.

There is no teaching within these references, and no technical reason known to the person of ordinary skill, as to why the teachings of these references could or should be combined, and even if combined, the product would be a uniformly treated part, not a part with increased hardness of a gear wheel of a crankshaft due to local differential thermal treatment or peening. From combining the teachings one would arrive only at parts which are uniformly treated.

In the Final Office Action the Examiner submits that the references are combinable since Oyelayo teaches that the carbide coating improves wear resistance and increases pitting resistance (see paragraph [0001]).

Appellants maintain that the technical disclosures of the two references are so different, as explained above, as to not be reasonably be combinable to teach the common technical features of the present claims.

Accordingly, the above listed same common special technical feature of the present invention

- being recited literally in claims 4, 5 and 6, and
- not being disclosed in or obvious over the prior art,

it follows that claims 3-6 are drawn to the same invention. Withdrawal of the Restriction Requirement is in order.

The Examiner notes that product by process claims are limited only to the resulting structure of the process, where the resulting structure is the combined crankshaft and drive gear wheel that is hardened and has a carbide coating. The product claims do not require differential hardening, but instead only require that the device is hardened. It is clear that Group II fails to make a contribution over the prior art in light of Hoyes (WO 00/47362) in view of Oyelayo et al (2002/0098392). Since both groups do not share a "special technical feature" and there is no unity of invention between the two groups.

In response, Appellants point out that claim 6, like claims 4 and 5, requires at least one of (a) the heat treatment is controlled ***locally differentially*** such that ***locally the hardness***

is further increased, or (b) the durability of the gear wheel is ***locally increased*** by peening, and that the friction wear resistance of the teeth of the gear wheel is increased by application of carbide containing coatings.

The local differential hardening, particularly combined with further improvement of friction wear resistance of the teeth of the gear wheel by introduction of carbide, is not taught in the cited combination of prior art.

Applicants respectfully submit that the claims, fairly read, all read on the same invention, and encompass the same special technical features.

In the Final Office Action the Examiner responds to Appellant's argument that tempered ductile iron is common to all claims. This is not found persuasive because the method claims do not positively require "tempered ductile iron."

In response, Appellants refer the Examiner to all independent claims 4, 5 and 6 reciting the term "tempered ductile iron (ADI)".

In response to Appellant's argument that the product would be uniformly treated, and not partially treated due to local differential thermal treatment, the Examiner finds this not to be persuasive because "local differential" treatment doesn't necessarily involve a partially treated workpiece, as the local treatment could be "local" to the combined drive gear wheel and crankshaft as opposed to other engine components. Therefore, a uniformly coated combined drive gear wheel and crankshaft can also have local different differential thermal treatment.

In response, Appellants submit that the claim, read in it's entirety, provides "wherein crankshaft and gear wheel exhibit ***differential hardening***, ... wherein the ***hardness of the gear wheel is further increased*** by at least one of (a) local differential thermal treatment during ADI heat treatment and (b) peening" clearly indicates that the gear wheel is of a different hardness than the crank shaft, thus the Examiner's interpretation that the claim language "local treatment" has the same meaning as "uniform treatment" is not reasonable. . The present claims recite that the hardness of the gear wheel is further increased over the not-increased-hardness part by at least one of (a) local differential thermal treatment during ADI heat treatment and (b) peening. As disclosed in paragraph [0015], the area of the gear wheel preferably exhibits a higher hardness relative to the rest of the cast part. This can be accomplished by suitable differentially controlled temperature exposure during the thermal treatment of the different cast partial areas, or by cold hardening (so called shot blasting or

peening). Since all the claims require either local differential heat treatment or peening, not taught in the cited prior art, all the claims involve the same special technical features.

In the Final Office Action the Examiner indicates that this is not found persuasive because the specification hasn't clearly set forth how differential treatment will differ from heat treatment as disclosed in Noyes, therefore it is unclear how the two treatments would result in a structurally different combined crankshaft and gear wheel. Since the structural differences cannot be determined, then the product by process claims of Group I do not make a contribution over the prior art.

In response, Appellants point out that those of ordinary skill in the art, having the present specification before them, would find that one of (a) local differential thermal treatment during ADI heat treatment and (b) peening would locally increase the hardness of the gear wheel. This feature not being present in the cited prior art, it remains evident that the present product-by-process claims and process claims recite inventive common technical features and should be examined together.

Reversal of the restriction requirement and examination of claims 6 and 3 is thus respectfully requested.

CLAIMS 4-5, 7-9 AND 11-13 ARE PATENTABLE OVER HOYES ET AL IN VIEW OF WILDE ET AL FURTHER IN VIEW OF OYELAYO ET AL

On page 4 of the Office Action, claims 4-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hoyes et al (WO 0047362) in view of Wilde et al (6,258,180), further in view of Oyelayo et al (2002/0098392).

Appellants respectfully submit that these references at best reflect the state of the art as discussed in the background section of the present application, but do not suggest the present inventive contribution to the art.

The Examiner has at best found prior art corroborating technical details of the present invention. However, the Examiner has not found prior art that would suggest the departure from conventional wisdom necessary to arrive at the radical idea which forms the basis of the present invention.

Motors with a high power density and ignition pressure, for example diesel engines, require crankshafts with combined gear wheels, which are subjected to high loads,

particularly in the areas in which they are joined. Hardened gear wheels are conventionally joined to forged steel crankshafts by material joining (welding), form-fitting engagement (screwing) or by interference fit (specification, paragraph [0004]).

The present invention improves over the prior art by casting the crankshaft and drive gear wheel as one piece. The prior art does not suggest this improvement, and the Examiner appears to overlook this essential limitation.

Independent **claim 4** claims a diesel powered vehicle, wherein:

(a) the diesel engine includes a crankshaft with combined drive gear wheel;

(b) ***both the crankshaft and drive gear wheel are cast as one piece.*** Conventionally, the number of the processing steps for manufacturing a crankshaft with combined drive gear wheel requires comparatively lengthy manufacturing times, which drives up costs (paragraph [0008]). Casting the crankshaft together with the combined gear wheel as a single piece reduces manufacturing times and cost by (paragraph [0010]), eliminating the joining step, and elevating the degree of design freedom (paragraph [0011]);

(c) crankshaft and gear wheel exhibit differential hardening (see (e) below);

(d) both crankshaft and gear wheel are manufactured from tempered ductile iron (ADI). As disclosed in paragraph [0012] and [0013] of the specification, tempered ductile iron (ADI), a cast iron with spherical graphite which, following targeted thermal treatment (tempering), exhibits improved wear characteristics. Further, ADI has approximately a 10% lower weight than the conventionally employed steel, and exhibits excellent thermal and mechanical characteristics, in particular high strength up to 1600 N/mm^2. Due to these positive characteristics of the ADI material one can completely dispense with the conventionally required step of hardening of the gear wheel;

(e) the hardness of the gear wheel is further increased by at least one of (a) local differential thermal treatment during ADI heat treatment and (b) peening. As disclosed in paragraph [0015], the area of the gear wheel preferably exhibits a higher hardness relative to the rest of the cast part. This can be accomplished by suitable differentially controlled temperature exposure during the thermal treatment of the different cast partial areas, or by cold hardening (so called shot blasting or peening); and

(f) the friction wear resistance of the gear teeth is increased by application of carbide containing coatings (CADI). As disclosed in paragraph [0016], the hardness of the cast part can be increased locally, for example the teeth, by locally introducing carbide into the melt. This can occur using carbide-containing coatings or finishings. Thereby one obtains an ADI

microstructure with supplemental introduced carbides (so called carbidic ADI=CADI). The thus hardened areas exhibit an increased resistance to wear.

Claims 4 and 5 differ only in the preamble. Where claim 4 is directed to a diesel powered vehicle with the inventive crankshaft, claim 5 is directed to the crankshaft *per se.*

According to the Examiner, with respect to claims 4-5, 7-9, 11-13, Hoyes et al teaches a diesel engine including a crankshaft with combined drive gear wheel (see Figure 1, column 1 lines 1-2, and note that it is inherent that the diesel engine will be used for a diesel vehicle), and wherein crankshaft and gear wheel are hardened (see column 1 lines 21-22).

Turning to Hoyes et al in greater detail, Appellants point out that Hoyes ***forges*** a crankshaft with a round gear wheel, and must cut the gear teeth into the gear wheel after forging. This cutting into a forged surface results in a necessarily different surface microstructure than would be produced in accordance with the present invention where:

- both the crankshaft and drive gear wheel, with teeth, are ***cast*** (not forged) together as one piece,
- the crank shaft and gear wheel exhibit ***differential hardening*** (claim 4, line 3; claim 5, lines 2-3),
- both the crank shaft and gear wheel are manufactured from ***tempered ductile iron (ADI*** – a cast iron with spherical graphite which, by targeted thermal treatment, exhibits improved wear characteristics), ADI being about 10% lower in weight than conventionally employed steel,
- the hardness of the gear wheel is further increased by at least one of (a) ***local differential thermal treatment*** during ADI heat treatment or (b) peening, and
- the ***friction wear resistance of the gear teeth is increased*** by application of carbide containing coatings (CADI) (e.g., into the melt to obtain an ADI ***microstructure with supplemental introduced carbides – see claims 9 and 13***).

Hoyes ***forges*** a crankshaft with gear wheel ***without teeth***. Since the gear teeth are not formed in the forging step, but rather must be cut into the gear wheel subsequent to forging, any microstructure treatment imparted to the surface of the gear disk for increased friction wear, as by application of carbide coatings according to the present invention, prior to cutting teeth would not survive. Thus, Hoyes can not possibly suggest the present invention.

Hoyes discloses a uniform heat treatment of the entire crankshaft, or induction heating of the gear wheel (apparently ***prior*** to cutting the gear teeth), but without the use of the tempered ductile iron (ADI), without the casting, without the integral forming of teeth, without the differential increased carbide in the gear teeth. Hoyes thus at best hardens the gear wheel only, thus exhibits only two different areas of hardness.

In contrast, the crankshaft of the present invention will actually exhibit ***three*** different areas of hardening due to the recited steps, i.e., there are two different ADI steps, and one CADI step, resulting in three different areas of hardness. Thus Hoyes is far from the present invention.

According to the Examiner, the limitations, "wherein the hardness of the gear wheel is further increased by local differential thermal treatment during ADI heat treatment and/or by peening, ***wherein both the crankshaft and drive gear wheel are cast as one piece***" is being treated as a product by process limitation. As set forth in MPEP 2113, product by process claims are NOT limited to the manipulations of the recited steps, only to the structure implied by the steps. Once a product appearing to be substantially the same or similar is found, a 35 U.S.C. 102/103 rejection may be made and the burden is shifted to applicant to show an unobvious difference See MPEP 2113. The structure implied by the above process steps is a crankshaft combined with a drive gear wheel manufactured from tempered ductile iron (ADI), has been heat treated and at least the gear teeth having a carbide containing coating (CADI).

In response, Appellants respectfully submit that a one piece cast structure is different from a two piece joined structure as explained above, and the Examiner should have considered that the state of the art at the time of the present invention involved separately forming and then joining hardened gear wheels to forged steel crankshafts by material joining (welding), form-fitting engagement (screwing) or by interference fit (specification, paragraph [0004]). This conventional joining-of-two-pieces was considered necessary since the two pieces performed different duties, and had to have different properties. **The prior art did not suggest that these two dissimilar pieces - the crankshaft and drive gear wheel – could be cast as one piece.** As explained in the specification, conventionally, the number of the processing steps for manufacturing a crankshaft with combined drive gear wheel requires comparatively lengthy manufacturing times, which drives up costs (paragraph [0008]). Casting the crankshaft together with the combined gear wheel as a single piece reduces manufacturing times and cost by (paragraph [0010]), eliminating the joining step, and

elevating the degree of design freedom (paragraph [0011]).

Thus, a one-piece crankshaft and drive gear wheel is a significant improvement over and different from a two piece unit in large part since it can be manufactured more economically and efficiently than a two piece unit. The process steps of the product by process claim are material limitations which must be given consideration.

The Examiner acknowledges that Hoyes et al fail to teach wherein the crankshaft and drive gear wheel are manufactured from tempered ductile iron (ADI) and have a carbide containing coating (CADI).

In response, Appellants first point out that the Examiner is not considering the most important limitation of the present claims – the fact that the crankshaft and the gear wheel – two dissimilar parts with dissimilar functions and traditionally formed of dissimilar materials – can be and are cast together quickly and economically as a single piece. The idea that a one-piece casting would have been able to meet both the requirements of the crank shaft and the gear wheel would have been surprising to those working in this art. Nothing in the cited references suggests this departure from accepted wisdom.

Wilde et al is cited for teaching producing ***a crankshaft*** out of an austempered ductile iron (see column 2 lines 55-60, where it discloses producing crankshafts, and see column 4 lines 4-12).

Appellants point out that this reference does not suggest that the crankshaft ***and the gear wheel*** –two dissimilar parts with dissimilar functions and traditionally formed of dissimilar materials – can be and are cast together quickly and economically as a single part.

Wilde et al simply teach that ductile iron castings are widely used in the automotive industry for crankshafts, camshafts, steering knuckles, pinions, gears, and many other components, and for a variety of machinery applications, marine applications, and equipment used in the paper and glass industries. However, primary iron carbides in ductile iron castings are normally quite ***detrimental*** as they reduce the machinability, ductility and impact properties. One recent approach has been the use of tempered ductile iron (hereinafter referred to as "ADI"). Although ADI represented a significant step toward finding a satisfactory solution for this problem, the abrasion characteristics (e.g., wear resistance) of the tines produced with ADI were not completely satisfactory. a cast iron component that has undergone an austempering process is comprised of primary iron carbides ***uniformly*** dispersed throughout a substantially ausferritic matrix. Thus, there is no teaching of ***surface***

treatment, particularly of treatment of the ***gear wheel only,*** and most specifically, of the ***teeth only*** (claims 9 and 13), of an article which is a combination crankshaft and gear wheel.

Next, according to the Examiner, Oyelayo discloses plasma treatment (sputtering) a carbide coating on gear teeth (see [0029]).as an alternative to heat treatment.

Appellants point out that this reference teaches ***coating***, not ***incorporating*** carbide into the alloy. Further, this reference does not teach the specific use of tempered ductile iron, a cast iron with spherical graphite which, by targeted thermal treatment (tempering), exhibits improved wear characteristics.

Further, the Oyelayo treatment is non-selective and is applied to the entire part. There is no way to use the method of Oyelayo to selectively harden only gear teeth. Further, since sputtering acts on the entire piece, it is not even possible to carry out selective treatment. Further, the process involves forming a first layer of, e.g., boron carbide, a second layer of, e.g., a mixture of boron carbide and boron oxide, and a third layer of, e.g., boron oxide. There is no mention of heat treatment such that the carbide is introduced into the microstructure of the alloy, and in particular ADI, as in the present invention.

There is no teaching within these three references, and no technical reason known to the person of ordinary skill, as to why the teachings of these references could or should be combined, and even if combined, the product would be a uniformly treated part, not a part with increased hardness of a gear wheel of a crankshaft due to local differential thermal treatment or peening. From combining the teachings one would arrive only at parts which are uniformly treated.

Turning to claims 7 and 11 (increasing hardness by local differential thermal treatment), the Examiner considers that this limitation can be ignored as product by process limitation. Once a product appearing to be substantially the same or similar is found, a 35 U.S.C. 102/103 rejection may be made and the burden is shifted to applicant to show an unobvious difference See MPEP 2113. Further, the Examiner interprets the term "local" can mean the entirety of the gear wheel and crankshaft as it does state that the combined gear wheel itself is being hardened.

In response, Appellants point out that in the context of the present claims it is clear that "local" refers to the gear wheel and can not refer to the entire part, as the claim recites that the crankshaft and gear wheel exhibit differential hardening. Further, those of ordinary skill, and the references cited by the Examiner, confirm that parts can be hardened. What the prior art does not teach, however, is that a crankshaft and gear wheel can be cast as a single

piece, and that this piece can be processed so that two parts of the piece are adapted to perform different functions and meet different requirements.

Next, with regard to claims 8, 9, 12, 13, the Examiner considers Noyes et al/Wilde et a/Oyelayo et al teach the product of claims 7 and 11, but fail to teach wherein carbide is within the microstructure of the combined gear wheel and crankshaft. Note that the claim is being treated as a product by process claim, as described above, and the resulting structure is carbides throughout the thickness of the part. Wilde et al teaches uniformly dispersing carbides throughout the microstructure of an ADI part to form a part having carbides throughout its thickness (see column 3 lines 66- 67 — column 4 lines 1-12).

Again, the Examiner does not give any weight or significance to the limitation that the gear wheel is hardened by local introduction of carbide. Appellants submit that the claim language should be given a reasonable interpretation. The cited references do not teach casting a single piece crankshaft and gear wheel, with ***local*** hardening of the gear wheel part by ***local*** incorporation of carbide.

CLAIMS 10 AND 14 ARE PATENTABLE OVER HOYES ET AL IN VIEW OF WILDE ET AL FURTHER IN VIEW OF OYELAYO ET AL AND FURTHER IN VIEW OF KAWANAMI

The Examiner rejects claims 10 and 14 under 35 U.S.C. 103(a) as being obvious over Noyes et al (WO 0047362) in view of Wilde et al (6,258,180), further in view of Oyelayo et al (2002/0098392) as applied to claims 4 and 5 above, further in view of Kawanami et al (5,409,415). Kawanami et al teaches shot peening a gear wheel to form a shot peened gear wheel (see column 7 lines 56-68 - column 8 lines 1-4).

In response, Appellants submit that these references do not teach the basic invention, namely, that a crankshaft and gear wheel can be cast as a single piece. The present invention represents a radical departure from conventional wisdom, which olds that crankshaft and gear wheel have different functions, and must be made of different materials which are then joined to form the part.

No reference teaches hardening of a gear wheel which is a cast as a unitary part together with the crankshaft. Oyelayo fails to selectively harden only the gear teeth.

The Examiner takes the position that the claims are not restricted to hardening of the gear teeth only, but instead may be construed to teach an entire combined gear wheel and crankshaft which is hardened, along with the gear teeth.

Appellants in response refer to the plain claim language "wherein ***crankshaft and gear wheel exhibit differential hardening***, wherein both are manufactured from tempered ductile iron (ADI), wherein the ***hardness of the gear wheel is further increased by*** at least one of (a) local differential thermal treatment during ADI heat treatment and (b) ***peening***,

If the claim is interpreted in the manner proposed by the Examiner, the crankshaft and gear wheel could not exhibit differential hardening.

Accordingly, it is believed that all rejections should be reversed and the present claims passed to allowance.

The Commissioner is hereby authorized to charge any fees which may be required at any time during the prosecution of this application without specific authorization, or credit any overpayment, to Deposit Account Number 16-0877.

Respectfully submitted,

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Appendix – Claims

3. A process according to Claim 6, wherein it involves chill molding or chill casting.

4. A diesel powered vehicle, wherein the diesel engine includes a crankshaft with combined drive gear wheel, wherein both the crankshaft and drive gear wheel are cast as one piece, wherein crankshaft and gear wheel exhibit differential hardening, wherein both are manufactured from tempered ductile iron (ADI), wherein the hardness of the gear wheel is further increased by at least one of (a) local differential thermal treatment during ADI heat treatment and (b) peening, and wherein the friction wear resistance of the gear teeth is increased by application of carbide containing coatings (CADI).

5. A crankshaft with combined drive gear wheel, wherein both crankshaft and drive gear wheel are cast as one piece, wherein crankshaft and gear wheel exhibit differential hardening, wherein both are manufactured from tempered ductile iron (ADI), wherein the hardness of the gear wheel is further increased by local differential thermal treatment during ADI heat treatment and/or by peening, and wherein the friction wear resistance of the gear teeth is increased by application of carbide containing coatings (CADI).

6. A process for manufacturing a crankshaft with combined drive gear wheel, wherein both crankshaft and drive gear wheel are cast as one piece, wherein a base alloy suitable for tempered ductile iron (ADI) is employed as casting material and heat treated, wherein at least one of (a) the heat treatment is controlled locally differentially such that locally the hardness is further increased, or (b) the durability of the gear wheel is locally increased by peening,

and wherein the friction wear resistance of the teeth of the gear wheel is increased by application of carbide containing coatings.

7. The diesel powered vehicle according to claim 4, wherein the hardness of the gear wheel is increased by local differential thermal treatment during ADI heat treatment

8. The diesel powered vehicle according to claim 7, wherein carbide is locally introduced into the melt to obtain an ADI microstructure with supplemental introduced carbides in the cast part.

9. The diesel powered vehicle according to claim 7, wherein the friction wear resistance of the gear teeth is increased by locally introducing carbide into the melt in the area of the cast teeth to obtain an ADI microstructure with supplemental introduced carbides in the area of the teeth of the cast part.

10. The diesel powered vehicle according to claim 4, wherein the hardness of the gear wheel is increased by by peening.

11. The crankshaft with combined drive gear wheel according to claim 5, wherein the hardness of the gear wheel is increased by local differential thermal treatment during ADI heat treatment

12. The crankshaft with combined drive gear wheel according to claim 11, wherein carbide is locally introduced into the melt to obtain an ADI microstructure with supplemental introduced carbides in the cast part.

13. The crankshaft with combined drive gear wheel according to claim 11, wherein the friction wear resistance of the gear teeth is increased by locally introducing carbide into the melt in the area of the cast teeth to obtain an ADI microstructure with supplemental introduced carbides in the area of the teeth of the cast part.

14. The crankshaft with combined drive gear wheel according to claim 5, wherein the hardness of the gear wheel is increased by by peening.

Evidence Appendix:

No evidence pursuant to §§ 1.130, 1.131, or 1.132 or any other evidence has been entered by the Examiner and relied upon by appellant in the appeal.

Related Proceedings Appendix:

No prior or pending appeals, interferences or judicial proceedings are in existence which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in this appeal. Accordingly, no copies of decisions rendered by a court or the Board are available.